Toxicology of Pesticides

Hazard Recognition

What is Special about Pesticides?

Pesticides are a class of hazardous chemicals that are released into the environment in a controlled fashion to accomplish their particular function.

They are also one of the few materials that are intentionally added to our food supply.

They are also designed with lethality in mind.

Dose/Response

Paracelsus (Theophrastus Phillippus Aureolus Bombastus von Hohenheim)

"What is it that is not poison? All things are poison and nothing is without poison. The right dose differentiates a poison and a remedy."

He also accused those who disagreed "ignorant cabbages", "sausage stuffers" and "high asses", but these are little quibbles.

Dose/Response

Dose Terminology

LD_{50} = Lethal Dose 50% Test Population

LD_0 = Highest Dose with no Lethality in the Test Population

LD_{100} = Lethal Dose 100% Test Population

LC_{50} = Lethal Concentration 50% Test Population

LOAEL =Lowest Observed Adverse Effect Level

NOAEL = No Observed Adverse Effect Level

Dose/Response

Exposure Terminology

Acute: Short term, high dose, usually measured in minutes to days, can be multiple doses within a short period (burst hose on a azinphos-methyl application or a B.T. Collins Cocktail).

SubChronic: Intermediate term, moderate to low dose, measured in weeks to months (exposure to a seasonal use material, e.g. triadimefon on grapes) .

Chronic: Long term, low dose, measured in months to years (exposure to a constant use material, e.g. sulfuryl fluoride for home fumigation).

Pesticides
General Classes

Insecticides

1. *Organophosphates (OP)*
2. *Carbamates*
3. *Chlorinated Hydrocarbons (CHC)*
4. Pyrethroids
5. Biologicals
6. Metals/Elementals
7. Insect Growth Regulators (IGR)

Pesticides
General Classes

Fungicides

1. Substituted benzenes
2. Thiocarbamates
3. EBDC
4. Phthalates
5. Metals/Elements
6. Others

Pesticides
General Classes
Rodenticides

1. ***Coumarins***
2. ***Indandiones***
3. ***Metals/Inorganics***
4. ***Convulsants***

Pesticides
General Classes

Herbicides

1. *Chlorophenoxy*
2. *Nitro-phenolic/cresolic*
3. *Dipyridyls*
4. Triazines
5. Thiocarbamates
6. *Phosphonates*
7. Others

Pesticides
General Classes
Fumigants

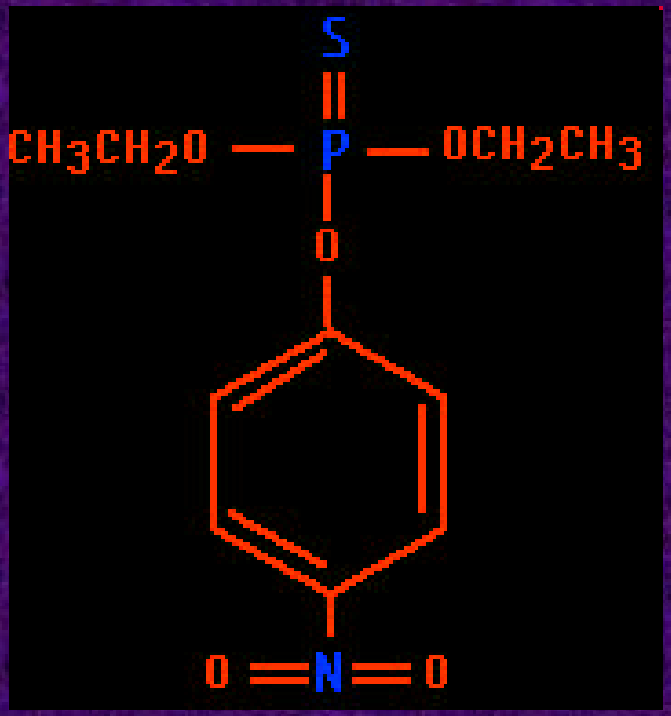
1. Methyl bromide
2. Sulfuryl fluoride
3. Chloropicrin
4. Acrolein
5. Phosphine
6. 1,3-dichloropropene
7. Hydrogen cyanide
8. Formaldehyde

Pesticides
Insecticide Toxicology

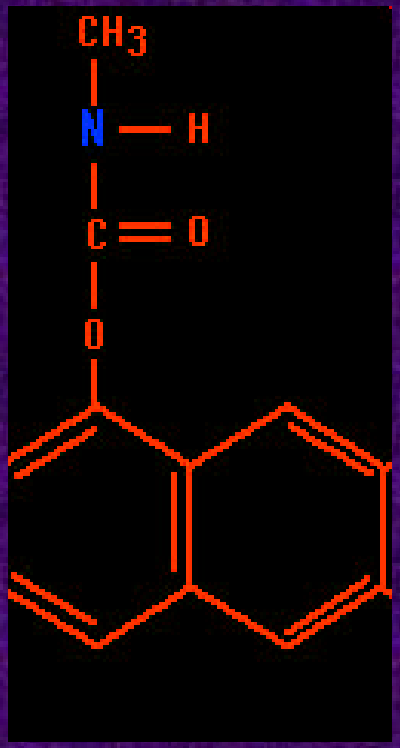
OP	Carbamates
Parathion	Propoxur
Azinphos-methyl	Methomyl
Diclorvos	Carbofuran
Naled	Aldicarb
Fenamiphos	Carbaryl
Methidathion	Fenoxycarb
Oxydemeton-methyl	Thiodicarb
malathion	Oxamyl

Pesticides

OPs and Carbamates



Parathion



Carbaryl

Pesticides
OPs and Carbamates

Both inhibit acetylcholinesterase (AChE); carbamates do so reversibly.

Oxons of OPs tend to be more toxic (malathion vs maloxon)

OPs generally are more easily absorbed through the skin than carbamates (same is true of EC formulations).

Can come in various formulations with various solvents.

Toxicity varies.

Symptoms: Headache, nausea, vomiting, weakness, hypersecretion, twitching, diarrhea, seizures, LOC, pulmonary edema.

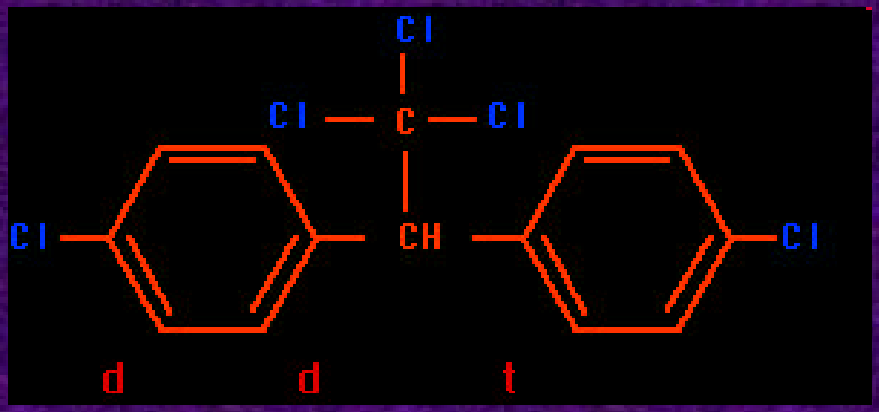
Pesticides
CHCs

dichloro diphenyl trichooroethane	***chlordane***	***endrin***
dienochlor	***heptachlor***	**methoxychlor**
chlorobenzilate	***benzene hexachloride***	***chlorodecone***
mirex	**lindane**	***dieldrin***
dicofol	***toxaphene***	**endosulfan**

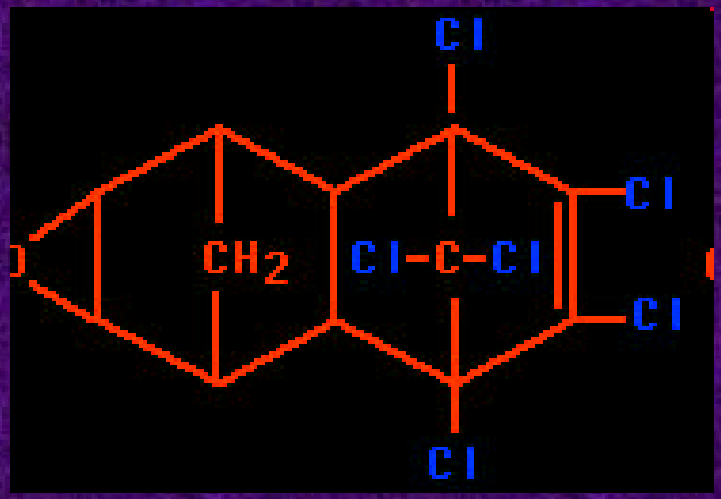
Red **=** cancelled

Pesticides

CHCs



DDT



Dieldrin

Pesticides
CHCs

Most CHCs which tended to lipid storage have been cancelled.

Remaining CHCs usually rapidly metabolized and excreted.

Lindane, the cyclodienes and endosulfan can be dermally absorbed. DDT is very poorly absorbed through skin.

Most of the highly toxic CHCs are cancelled in USA.

Symptoms: Headache, dizziness, nausea, vomiting, tremor, hyperesthesia/paresthesia, convulsions, coma, death.

Blood levels of CHCs and metabolites can be measured.

Pesticides
Fungicides

Most fungicides are usually dermal irritants, eye irritants, respiratory irritants, and potential sensitizers.

The thiocarbamate fungicides may have an Antabuse reaction.

The metallic materials (copper) can be corrosive to eyes and mucus membranes.

Organometallics (Cu, Hg, Sn, Cd) also cause systemic illnesses; most are no longer registered in USA.

Symptoms vary. Hg organometallics are extremely hazardous.

Pesticides
Rodenticides

Warfarin, bromadiolone, brodifacoum, chlorophacinone, etc. are all hemorrhagic agents. Warfarin is medically prescribed as coumadin.

Thallium sulfate in non-lethal doses can cause painful neuropathies, seizures, dementia and coma. Not registered in USA.

Zinc phosphide dust inhalation causes pulmonary edema. Ingested material will evolve phosphine gas in the gut.

Yellow phosphorous is highly corrosive and unavailable in the USA.

Convulsants include 1080*, crimidine and strychnine.

Pesticides
Herbicides

Chlorophenoxy materials are dermal and mucous membrane irritants. Dermal absorption is low.

The nitro-cresolic/phenolics are very toxic and easily absorbed through the skin. Causes yellow discoloration of skin/eyes/hair. Decouples oxidative phosphorylation; used as “diet pill” (1933).

Dipyridyl paraquat is a severe skin/eye irritant and is usually fatal in even small (20ml of 20%) doses. Diquat is a neurological toxicant.

One phosphonate formulation was corrosive to the eyes, not from the glyphosate, but from the surfactants. It was reformulated to remove the problem material.

Pesticides
Fumigants

Methyl bromide is phasing out of use. Greatest use is still agricultural (commodity, field), while structural is dropping. Can cause dermal burns if trapped against the body. Inhalation can cause pulmonary edema and convulsions.

Sulfuryl fluoride is irritating to mucous membranes. Has become major material for structural use.

Chloropicrin and acrolein are strong lachrymators and severely irritating.

Phosphine is an upper respiratory tract irritant that can cause nausea, tachycardia, paresthesia.

Pesticides
Others

IGRs are usually of very low toxicity

“Organic” pesticides can be highly toxic (nicotine), sensitizers (pyrethrum), dermal irritants (rotenone) or essentially harmless (BT).

Mixing Clorox® with ammonia is considered a violation of label. Mixing Purex® with ammonia is considered stupid.

Arsenicals are still have insecticidal and wood preservative uses.

DEET (DIETHYL TOLUAMIDE) can cause dermatitis in the antecubital and popliteal fossae.

Sugar is a registered pesticide in California (Reg.# 39834-50002-


Do your eyes feel like mine look? Take a 5 minute stretch.